CLAIMS

We claim:

1. A fire detector unit for detecting fire in a region, said unit comprising:

a chemical sensor for monitoring said region for a combustion chemical and including a first measurable parameter which changes in value proportional to concentration levels of said monitored combustion chemical, said first measurable parameter being ambient temperature dependent;

a temperature sensor disposed in proximity to said chemical sensor and including a second measurable parameter which changes in value proportional to the ambient temperature of said chemical sensor; and

a processor circuit coupled to said chemical sensor and temperature sensor for reading said first and second measurable parameters thereof, said processor circuit operative to process said first and second parameter readings to generate a temperature compensated concentration level of said monitored combustion chemical, and to generate an alarm based on said generated temperature compensated concentration level.

2. The fire detector unit of claim 1 including a memory storing a look-up table of temperature compensated, gas concentration levels of the monitored combustion chemical; and wherein the processor is coupled to said memory and operative to utilize said look-up table based on the first and second parameter readings to generate the temperature compensated concentration level of the monitored combustion chemical.

3. The fire detector unit of claim 2 wherein the temperature compensated, gas concentration levels of the look-up table are based on a function of the first parameter reading, and a first parameter measurement corresponding to a predetermined combustion chemical concentration and a temperature factor value, both said first parameter measurement and temperature factor value determined from the second parameter reading.

4. The fire detector unit of claim 1 wherein the processor circuit is operative to generate the temperature compensated concentration level based on a function of the first parameter reading, and a first parameter measurement corresponding to a predetermined combustion chemical concentration and a temperature factor value, both said first parameter measurement and temperature factor value determined from the second parameter reading.

5. The fire detector unit of claim 4 including a memory storing data representative of a curve of first parameter measurements vs. temperature corresponding to the predetermined combustion chemical concentration; and wherein the processor circuit is coupled to said memory for accessing the first parameter measurement corresponding to the predetermined

combustion chemical concentration from said stored data based on the second parameter reading.

6. The fire detector unit of claim 5 wherein the memory stores data representative of a temperature factor vs. temperature curve; and wherein the processor circuit is operative to access the temperature factor value from said stored data based on the second parameter reading.

7. The fire detector unit of claim 6 wherein the data representative of the curve of the predetermined combustion chemical concentration and data representative of the curve of the temperature factor are stored in the memory in the form of look-up tables.

8. The fire detector unit of claim 4 including a memory for storing data representative of a first temperature factor vs. temperature curve and data representative of a second temperature factor vs. temperature curve; and wherein the processor circuit is operative to access a selected one of the first and second temperature factor values from said stored data based on the second parameter reading for use in generating the temperature compensated concentration level.

9. The fire detector unit of claim 1 wherein the processor circuit is operative to generate an alarm based on a comparison of the generated temperature compensated concentration level and an absolute threshold.

10. The fire detector unit of claim 1 wherein the processor circuit is operative to generate an alarm based on a comparison of a time rate of the generated temperature compensated concentration level and a ramp threshold.

11. The fire detector unit of claim 1 wherein the processor circuit is operative to read time samples of the first measurable parameter and to generate a temperature compensated concentration level for each time sample based on said time sample readings; and including a memory, said processor operative to store in said memory a sliding window in time of a predetermined number of most recent generated temperature compensated concentration levels.

12. The fire detector unit of claim 11 wherein the processor circuit is operative to derive a time rate of the generated temperature compensated concentration levels as a difference of a current generated temperature compensated concentration level and a minimum generated temperature compensated concentration level from the stored predetermined number of generated temperature compensated concentration levels, and to set an alarm based on a comparison of the time rate of the generated temperature compensated concentration levels and a ramp threshold.

13. The fire detector unit of claim 12 wherein the processor circuit is operative to reset the alarm when the current generated temperature compensated concentration level of a time sample subsequent to setting the alarm falls below a return value.

14. The fire detector unit of claim 13 wherein the return value is a predetermined percentage of the current generated temperature compensated concentration level used to derive the time rate used to set the alarm.

15. The fire detector unit of claim 1 wherein the combustion chemical sensor comprises a sensor selected from the group consisting of a hydrogen gas sensor and a carbon monoxide gas sensor.

16. A method of detecting a combustion chemical in a region and setting an alarm based on concentration levels of the combustion chemical, said method comprising the steps of:

monitoring said region for a combustion chemical with a sensor having a measurable parameter which changes in value proportional to concentration levels of said monitored combustion chemical, said measurable parameter being ambient temperature dependent;

generating an ambient temperature measurement of said sensor; and

reading said measurable parameter and ambient temperature measurement;

processing said measurable parameter and ambient temperature measurement readings to generate a temperature compensated concentration level of said monitored combustion chemical; and

setting an alarm based on said generated temperature compensated concentration level.

17. The method of claim 16 including the steps of: storing a look-up table of temperature compensated, gas concentration levels of the monitored combustion chemical; and utilizing said look-up table based on the measurable parameter and ambient temperature measurement readings to generate the temperature compensated concentration level of the monitored combustion chemical.

18. The method of claim 17 including the step of generating the temperature compensated, gas concentration levels of the look-up table based on a function of the measurable parameter reading, and a sensor parameter measurement corresponding to a predetermined combustion chemical concentration and a temperature factor value, both said sensor parameter measurement and temperature factor value determined from the ambient temperature measurement reading.

19. The method of claim 16 wherein the step of processing includes generating the temperature compensated concentration level based on a function of the measurable

parameter reading, a sensor parameter measurement corresponding to a predetermined combustion chemical concentration and a temperature factor value, both said sensor parameter measurement and temperature factor value determined from the ambient temperature measurement reading.

20. The method of claim 19 including the steps of storing data representative of a curve of sensor parameter measurements vs. temperature corresponding to the predetermined combustion chemical concentration; and accessing the sensor parameter measurement corresponding to the predetermined combustion chemical concentration from said stored data based on the ambient temperature measurement reading.

21. The method of claim 20 including the steps of storing data representative of a temperature factor vs. temperature curve; and accessing the temperature factor value from said stored data based on the second parameter reading.

22. The method of claim 21 wherein the data representative of the curve of the predetermined combustion chemical concentration and data representative of the curve of the temperature factor are stored in the form of look-up tables.

23. The method of claim 19 including the steps of storing data representative of a first temperature factor vs. temperature curve and data representative of a second temperature factor vs. temperature curve; and accessing the first and second temperature factor values from said stored data based on the ambient temperature measurement reading.

24. The method of claim 16 wherein the alarm is set based on a comparison of the generated temperature compensated concentration level and an absolute threshold.

25. The method of claim 16 wherein the alarm is set based on a comparison of a time rate of change of the generated temperature compensated concentration level and a ramp threshold.

26. The method of claim 16 wherein the step of reading includes reading time samples of the measurable parameter; and wherein a temperature compensated concentration level is generated for each time sample based on said time sample readings; and including the step of storing a sliding window in time of a predetermined number of most recent generated temperature compensated concentration levels.

27. The method of claim 26 including the steps of deriving a time rate of the generated temperature compensated concentration levels as a difference of a current generated temperature compensated concentration level and a minimum generated temperature compensated concentration level from the stored predetermined number of generated temperature compensated concentration levels; and setting the alarm based on a comparison

of the time rate of the generated temperature compensated concentration levels and a ramp threshold.

28. The method of claim 27 including the step of resetting the alarm when the current generated temperature compensated concentration level of a time sample subsequent to setting the alarm falls below a return value.

29. The method of claim 28 including the step of determining the return value as a predetermined percentage of the current generated temperature compensated concentration level used to derive the time rate used to set the alarm.

30. A method of calibrating a fire detector unit comprising a sensor for monitoring a region for a combustion chemical, said method comprising the steps of:

measuring a parameter of said sensor at a plurality of predetermined chemical concentration levels and at a plurality of predetermined first temperatures, said sensor parameter changing in value proportional to concentration levels of said monitored combustion chemical and ambient temperature;

creating measured parameter vs. temperature curve data for each of said plurality of predetermined chemical concentration levels based on said parameter measurements;

deriving temperature factors at a plurality of second temperatures based on said created measured parameter vs. temperature curve data; and

creating temperature factor vs. temperature curve data based on said derived temperature factors.

31. The calibration method of claim 30 including the step of burning in the sensor under operating conditions for a predetermined time period.

32. The calibration method of claim 30 including disposing the fire detector unit in a test chamber for performing the step of measuring the sensor parameter.

33. The calibration method of claim 30 wherein the sensor parameter being measured comprises resistance.

34. The calibration method of claim 30 wherein the temperature factors are derived at the plurality of second temperatures based on a function of sensor parameter measurements at first and second predetermined chemical concentration levels and corresponding second temperatures.

35. The calibration method of claim 34 including the step of creating a second temperature factor vs. temperature curve data based on said derived temperature factors; wherein the temperature factors of the second temperature factor vs. temperature curve data are derived at the plurality of second temperatures based on a function of sensor parameter

measurements at second and third predetermined chemical concentration levels and corresponding second temperatures.

36. The calibration method of claim 30 including the step of storing the measured parameter vs. temperature curve data in the fire detector unit.

37. The calibration method of claim 36 wherein the measured parameter vs. temperature curve data is stored in the form of a look-up table.

38. The calibration method of claim 30 including the step of storing the temperature factor vs. temperature curve data in the fire detector unit.

39. The calibration method of claim 38 wherein the temperature factor vs. temperature curve data is stored in the form of a look-up table.

40. The calibration method of claim 30 including the step of creating a look-up table of temperature compensated, gas concentration levels of the monitored combustion chemical from the measured parameter vs. temperature curve data and the temperature factor vs. temperature curve data.

41. The calibration method of claim 40 including the step of storing the look-up table of temperature compensated, gas concentration levels in the fire detector unit.

42. A self-contained, fire detector unit for detecting fire in a region, said unit comprising:

a smoke detector for monitoring said region for smoke and generating a smoke alarm signal upon the detection of smoke in said region;

a plurality of chemical sensors, each sensor of said plurality for monitoring said region for a different combustion chemical and including a first measurable parameter which changes in value proportional to concentration levels of said monitored combustion chemical, said first measurable parameter being ambient temperature dependent;

a temperature sensor disposed in proximity to said plurality of chemical sensors and including a second measurable parameter which changes in value proportional to the ambient temperature of said chemical sensors; and

a processor circuit coupled to said plurality of chemical sensors, smoke detector and temperature sensor for reading the smoke alarm signal and said first and second measurable parameters thereof, said processor circuit operative to process said first parameter readings of each chemical sensor to generate a corresponding temperature compensated concentration level of said monitored combustion chemical based on the second parameter readings, and to generate an alarm based on a combination of said smoke alarm reading and generated temperature compensated concentration levels of the chemical sensors of said plurality.

43. The fire detector unit of claim 42 including:

a hollow housing having a top surface;

wherein the smoke detector is disposed at a first area of said top surface;

wherein the plurality of chemical sensors and the temperature sensor are disposed at a second area of said top surface; and

wherein the processor circuit is disposed within the hollow housing.

44. The fire detector unit of claim 43 including:

a first screened, protective shield disposed over the smoke detector and mounted to the top surface; and

a second screened, protective shield disposed over the plurality of combustion chemical sensors and the temperature sensor and mounted to the top surface.

45. The fire detector unit of claim 42 wherein the smoke detector includes built-in test circuitry for generating a first fault signal indicative of a fault condition in the smoke detector; and wherein the processor circuit includes: test circuitry coupled to each of the plurality of combustion chemical sensors for detecting a fault condition therein and for generating a second fault signal indicative of said fault condition; and means for inhibiting the generation of the fire alarm based on said first and second fault signals.

46. The fire detector unit of claim 45 including;

a communication bus;

a communication controller and transmitter coupled between the processor circuit and communication bus; and

wherein the processor circuit includes means for converting the fire alarm and fault signals into corresponding alarm and fault messages; and means for controlling said bus controller and transmitter for transmitting said alarm and fault messages over said communication bus.

47. The fire detector unit of claim 42 wherein the processor circuit comprises a programmed microcontroller.

48. The fire detector unit of claim 42 wherein the processor circuit includes: means for generating a sensor alarm signal for each chemical sensor of said plurality based on the generated temperature compensated concentration level corresponding to said chemical sensor; and means for generating the alarm based on a condition in which the smoke alarm signal and sensor alarm signals for all of the chemical sensors of said plurality are concurrently generated.

49. The fire detector unit of claim 42 wherein the plurality of combustion chemical sensors comprises: a hydrogen gas sensor and a carbon monoxide gas sensor.

50. A self-contained, dual channel fire detector unit for detecting fire in a region, said unit comprising:

a first channel comprising:

a first smoke detector for monitoring said region for smoke and generating a first smoke alarm signal upon the detection of smoke in said region;

a first plurality of combustion chemical sensors, each sensor of said first plurality for monitoring said region for a different combustion chemical and including a first measurable parameter which changes in value proportional to concentration levels of said monitored combustion chemical, said first measurable parameter being ambient temperature dependent;

a first temperature sensor disposed in proximity to said first plurality of combustion chemical sensors and including a second measurable parameter which changes in value proportional to the ambient temperature of said combustion chemical sensors; and

a first processor circuit coupled to said first plurality of combustion chemical sensors, first smoke detector and first temperature sensor for reading the first smoke alarm signal and said first and second measurable parameters thereof, said first processor circuit operative to process said first parameter readings of each chemical sensor of said first plurality to generate a corresponding temperature compensated concentration level of said monitored combustion chemical based on the second parameter readings, and to generate a first alarm based on a combination of said first smoke alarm reading and generated temperature compensated concentration levels of the chemical sensors of said first plurality; and

a second channel comprising:

a second smoke detector for monitoring said region for smoke and generating a second smoke alarm signal upon the detection of smoke in said region;

a second plurality of combustion chemical sensors, each sensor of said second plurality for monitoring said region for a different combustion chemical and including a first measurable parameter which changes in value proportional to concentration levels of said monitored combustion chemical, said first measurable parameter being ambient temperature dependent;

a second temperature sensor disposed in proximity to said second plurality of combustion chemical sensors and including a second measurable parameter which changes in value proportional to the ambient temperature of said combustion chemical sensors; and

a second processor circuit coupled to said second plurality of combustion chemical sensors, second smoke detector and second temperature sensor for reading the second smoke alarm signal and said first and second measurable parameters thereof, said second processor

circuit operative to process said first parameter readings of each chemical sensor of said second plurality to generate a corresponding temperature compensated concentration level of said monitored combustion chemical based on the second parameter readings, and to generate a second alarm based on a combination of said second smoke alarm reading and generated temperature compensated concentration levels of the chemical sensors of said second plurality.

51. The fire detector unit of claim 50 wherein the first and second channels are separate and independent of each other.

52. The fire detector unit of claim 50 including:

a hollow housing having a top surface;

wherein the first and second smoke detector are disposed at a first area of said top surface;

wherein the first plurality of combustion chemical sensors and the first temperature sensor are disposed at a second area of said top surface;

wherein the second plurality of combustion chemical sensors and the second temperature sensor are disposed at a third area of said top surface; and

wherein the first and second processor circuits are disposed within the hollow housing.

53. The fire detector unit of claim 52 wherein the first and second smoke detectors are contained in a common package.

54. The fire detector unit of claim 52 including:

a first screened, protective shield disposed over the first and second smoke detectors and mounted to the top surface; and

a second screened, protective shield disposed over the first and second plurality of combustion chemical sensors and the first and second temperature sensors and mounted to the top surface.

55. The fire detector unit of claim 50 wherein the each of the first and second smoke detectors includes built-in test circuitry for generating first and second fault signals indicative of a fault condition in the first and second smoke detectors, respectively; wherein the first processor circuit includes: test circuitry coupled to each of the first plurality of combustion chemical sensors for detecting a fault condition therein and for generating a third fault signal indicative of said fault condition; and means for inhibiting the generation of the first fire alarm based on said first and third fault signals; and wherein the second processor circuit includes: test circuitry coupled to each of the second plurality of combustion chemical

sensors for detecting a fault condition therein and for generating a fourth fault signal indicative of said fault condition; and means for inhibiting the generation of the second fire alarm based on said second and fourth fault signals.

56. The fire detector unit of claim 55 wherein the first processor circuit includes means for controlling the disposition of the first channel based on the first and third fault signals; and wherein the second processor circuit includes means for controlling the disposition of the second channel based on the second and fourth fault signals.

57. The fire detector unit of claim 55 wherein the first channel includes; a first communication bus; and a first bus controller and transmitter coupled between the first processor circuit and first communication bus; and wherein the first processor circuit includes means for converting the first fire alarm and first and third fault signals into corresponding alarm and fault messages; and means for controlling said first bus controller and transmitter for transmitting said alarm and fault messages over said first communication bus; and wherein the second channel includes; a second communication bus; and a second bus controller and transmitter coupled between the second processor circuit and second communication bus; and wherein the second processor circuit includes means for converting the second fire alarm and second and fourth fault signals into corresponding alarm and fault messages; and means for controlling said second bus controller and transmitter for transmitting said alarm and fault messages over said second communication bus.

58. The fire detector unit of claim 50 wherein the each of the first and second plurality of combustion chemical sensors comprises: a hydrogen gas sensor and a carbon monoxide gas sensor.